8-5-2011

Breaking the Iron Triangle: The Impact of Information Sufficiency on Project Portfolio Decisions

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ABSTRACT

IT project governance is plagued by an inability to stop projects that ultimately fail, resulting in the loss of scarce resources and IT departments unable to generate full value for money invested. This study investigates the impact of the measurement information framework on information sufficiency, a key factor in reaching effective decisions. Specifically, this research addresses the question "Does a Balanced Scorecard (BSC) measurement information framework provide higher information sufficiency and greater decision making efficacy than the traditional Quality-Cost-Schedule approach in a project governance context?" This question is addressed using a randomized counterbalanced experimental design. Results were encouraging with significant support for two of the three hypotheses positing improved outcomes from use of the Balanced Scorecard framework.

KEYWORDS

Balanced Scorecard, Quality-Cost-Schedule, Iron Triangle, Stage-gate™, IT project governance, Information sufficiency.

INTRODUCTION

The Standish Group's Chaos Report 2006 indicated that 65 percent of Information Technology projects reach challenged or failed status each year (Rubinstein, 2007). In October 2005, one of Britain's largest food retailers wrote off a $526 million supply-chain system and hired 3,000 additional store clerks to manually stock the shelves (Charette, 2005). In April 2005, the FBI abandoned its Virtual Case File (VCF) project after investing $170 million, leaving it with the same pre-9/11 case management system as before, and that system was five years more antiquated than when the VCF project began (Goldstein, 2005).

Project Portfolio Management (PPM) is the discipline that guides decision makers as they consider the components that make up their organization's project portfolio. This study addresses one key aspect of PPM, the one most relevant to IT departments' generating full value for money invested: "Are we investing in the right things" (Pennypacker and Retna, 2009). Ultimately, project governance decisions determine if a project will receive continued investment through completion or if the project and the firm's investments in it will end with an early termination.

In numerous organizational settings, the Balanced Scorecard framework has proven a useful tool for information collection and dissemination for decision making purposes. The present research study consists of an experiment comparing a traditional project measurement information framework using the "Iron Triangle" measures of Quality, Cost, and Schedule (QCS) against a proposed framework based on the Balanced Scorecard (Kaplan and Norton, 1992). This is the first known experimental study comparing the BSC and QCS measurement information frameworks.

LITERATURE REVIEW

This study explores the impact of measurement information framework choice on information sufficiency and decision making efficacy. Previous work in these areas is thus discussed in this section.

Measurement Information Frameworks

A measurement information framework is a comprehensive and objective set of attributes and metrics determined by internal and external stakeholders using industry best practices and the particular needs of the organization. It is used to collect, analyze, and process information to aid management in organizational decision making. Two common frameworks are

discussed here: the Quality-Cost-Schedule framework (predominant in IS project governance), and the Balance Scorecard framework (predominant in organizational governance).

Quality-Cost-Schedule – "The Iron Triangle."

The British Standard for project management (BS60794, 1996) defined project management as: "The planning, monitoring and control of all aspects of a project…to achieve the project objectives on time and to the specified cost, quality and performance." In keeping with this definition, project governance has been dominated for 60 years by a measurement information framework known as the "Iron Triangle" (Atkinson, 1999), consisting of Quality-Cost-Schedule (QCS) measures which are used to determine project performance, as shown in Figure 1. In a project governance meeting, the project manager and other key stakeholders normally report on quality issues, budget adherence (cost), and progress against the project's schedule as well as existing or potential risks to the project.

Previous researchers have recommended a variety of additional measures to supplement QCS in order to improve project outcomes (Toor and Ogunlana, 2010), but the QCS measures are still at the core of most project management practice.

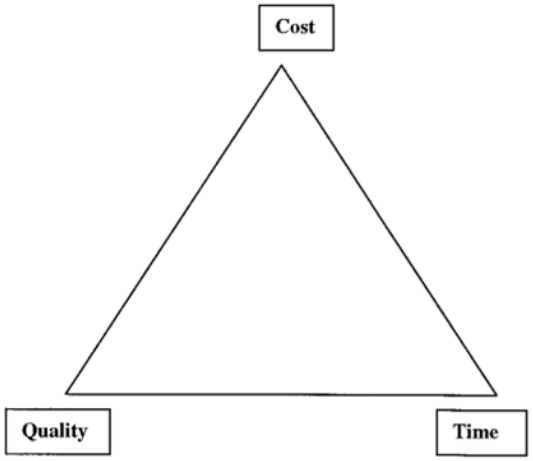

Figure 1. The Iron Triangle

Balanced Scorecard

One commonly-used organizational mechanism for collecting and disseminating information is the Balanced Scorecard (BSC) framework. Managers using the BSC framework take into account multiple perspectives when decisions are made and when performance is measured. The framework provides a system of checks and balances so that the major stakeholders in the firm and the four BSC perspectives (Financial, Customer, Process, and Learning & Growth) are represented in decision-making. The emphasis on multiple perspectives and communication among subject matter experts in each perspective are expected to improve information sufficiency for decision makers.

When a firm fully adopts BSC, every manager and executive of the firm routinely participates in multiple perspective decision-making (Kaplan and Norton, 1996). However, project management is often an exception, with projects still managed outside of the BSC framework (Cooke-Davies, 2002).

Another use of BSC in IT projects is as a multi-layer set of measurements for measuring the value of IS projects, as illustrated in Table 1. "The balanced scorecard forces management to take a broad view on ICT investments. This is one of the main advantages of this method" (Milis and Mercken, 2004). Decisions made by the executives must take into account all four perspectives with the stakeholders fully aware that this usually involves tradeoffs. For example, a strategy of expanding sales by implementing a new Customer Relationship Management (CRM) software suite that will help increase customer contact would likely entail changes to the sales and support processes. While this strategy should increase learning for the organization as employees interact more with the firm's customers, there would also be an immediate financial cost involved. The executives evaluating this project would do so with a need to strike a balance among the criteria. The nature of this BSC-based decision making approach will entail a broad range of information inputs demanded by the executives.

In the application of the Balanced Scorecard to projects, a project can conceptually and simply be viewed as a "mini-company" (Martinsons, Davison and Tse, 1999, Stewart and Carpenter-Hubin, 2000) and the goals of the "mini-company" must be kept in line with the overall corporate business strategy and the key stakeholder requirements.

In previous research, project management using a BSC framework has been shown to deliver better project performance results than the traditional QCS approach (Norrie and Walker, 2004). This research seeks to explore the use of the BSC in a project governance context.

Table 1: The Balanced Scorecard Metrics of an IT Project

Perspective	Finance	Customer	Process	Learning and Growth
Key Questions	Project within budget? Expected value of project?	Project meeting customer requirements?	Key process parameters under control?	Project competencies and skills available? Project adding to corporate competencies?
Key Considerations	- Estimated vs. actual cost - Expected costs vs. benefits	- Schedule - Functionality - Usability - Quality	- Process conformance - Defect trends - Schedule variance - Effort variance	- Lessons learned - Training

Information Sufficiency

When a decision maker achieves a state of perceived information sufficiency, they normally reach a decision within a short time thereafter. This study is based on previous research indicating that decision makers reporting high perceived information sufficiency demonstrated higher decision making efficacy (Scholten et al, 2007).

In order to measure efficacy of decision making, this study utilized project Stage-gates™ (Cooper and Kleinschmidt, 1995), a methodology involving event-based meetings of key project stakeholders in which the project's progress is formally reviewed by either a single decision maker or a decision making team. At the end of the meeting, a Go or Kill decision regarding the project's continuation must be provided for all stakeholders. For this study, Stage-gates™ provided a useful mechanism for clearly distinguishing between the outcomes of the two measurement information frameworks.

RESEARCH MODEL

The research question addressed in this study is "Does a Balanced Scorecard (BSC) measurement information framework provide higher information sufficiency and greater decision making efficacy than the traditional Quality-Cost-Schedule approach in a project governance context?" This question will be addressed using the Research Model shown in Figure 2 and detailed in the following three (3) hypotheses.

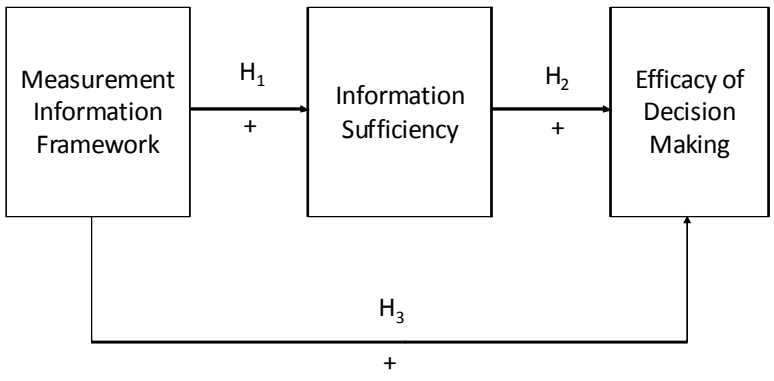

Figure 2: Research Model

The Balanced Scorecard framework's multiple perspectives (Financial, Customer, Process, and Learning) are addressed in key decisions made by an organization utilizing this framework (Speh and Brewer, 2000). In a project governance context, a Balanced Scorecard provides information regarding project cost, the project's customer feedback, the adherence of the project to organizational processes, and the project's contributions to organizational learning. The explicitly structured multi-perspective information framework is posited to provide the same project information in a more understandable format than the QCS "Iron Triangle." As a result, BSC is believed be better in fulfilling the decision makers' need for information sufficiency. This is stated formally as:

> ***Hypothesis 1 (H_1):*** A Balanced Scorecard measurement information framework for project governance will provide higher perceived information sufficiency as compared to a Quality-Cost-Schedule framework.

In previous research, it was demonstrated that a decision maker seeks information to assist in reaching a decision until a state of information sufficiency has been reached (Scholten et al, 2007). If a measurement information framework is used that provides superior information sufficiency, it is posited that decision makers will demonstrate improved decision making efficacy. In the context of project continuation decisions, it implies that they are more likely to render a decisive 'kill' decision for unwarranted projects at an earlier decision stage than those following the QCS method, thus minimizing economic losses on failing projects. Within the context of this study, this hypothesis is stated formally as:

> ***Hypothesis 2 (H_2):*** Greater perceived information sufficiency will result in decision makers exhibiting greater efficacy in decision making.

The first two hypotheses point to an indirect positive impact of the Balanced Scorecard framework on decision making efficacy, through the mediating impact of Information Sufficiency. The researchers posit that a direct impact also exists. It is posited that because the BSC measurement information framework is superior to the QCS framework, the decisions made using the BCS framework will be more effective – with or without an information sufficiency impact. This can be formally stated as:

> ***Hypothesis 3 (H_3):*** In a project governance context, the Balanced Scorecard measurement information framework will result directly in higher efficacy of decision making than the Quality-Cost-Schedule framework.

RESEARCH STUDY

Participants

The participants were MBA and Executive MBA students in a university in the southeastern United States. Participants consisted of 78% males and had an average of 7.4 years of work experience. All the participants had previous project management experience. The experiment was conducted as an integral part of a project management course and the participants were not provided with class credit or financial compensation.

Experimental Scenarios

A total of four different experimental scenarios were used, each based on an actual project and containing a predominance of negative indicators regarding project progress[1]. The scenarios were designed to present a project in trouble and warranting cancellation. A panel of project governance experts judged that in each scenario the most appropriate decision was to "Kill" the project.

Each scenario called for the participant to play the role of an executive decision maker in a fictitious organization that was partway through a software development project. The participant was required to render either a Go or Kill decision at the end of the simulated Stage-gate™. The scenarios were paper-based, each consisting of a two-page narrative describing the organization, the research participant's role, and the status of the project at the time of the Stage-gate™ meeting. The third page was a tabular presentation of quantitative measures of project performance using either BSC or QCS measures. For example, the BSC page contained data appropriate to each of the four BSC perspectives: Financial, Customer, Process, and Learning. Specific data included actual vs. budgeted cost, customer satisfaction level, programmer productivity and number of new certifications. The fourth page included the request for a clear Go or Kill decision and the research survey instrument (detailed in the Measures section). The fifth page collected demographic data (such as project experience and education).

[1] This prevalence of negative indicators was validated during the pilot phase and is reflected in the prevalence of Kill decisions made by the participants.

Two of the scenarios presented project progress information (one in BSC form, the other in QCS form) for Organization A: a fictitious government-run hospital in the United States replacing an assortment of applications with a single, integrated system. The system was being designed and built by a well-known, full line, information technology vendor.

The other two scenarios presented project progress information (again, one in BSC form, the other in QCS form) for Organization B: a fictitious agricultural implements manufacturing company deploying an Executive Information System and relying on internal resources for design and build.

The measures used in the BSC scenarios were recommended by prior BSC research (Kaplan and Norton, 1996, Milis and Mercken, 2004). The BSC measures reflecting the four perspectives included increase in annual net profit, customer feedback, introduction of new products, and a reusable code measure. Each perspective is presented by a different representative within the scenario. In the QCS scenarios, the measures are nearly identical to the BSC scenarios, but the emphasis is on Quality, Cost, and Schedule measures. Specific measures included software defect density per thousand function points, budgeted vs. actual cost, and number of days of schedule slippage.

Pilot Study

Before conducting the full study, a pilot was conducted with 4 participants and the feedback from the pilot study was incorporated into the experimental design. Based on pilot feedback, explanations of project performance measures were added to enhance clarity and understanding for participants. Wording of some elements of the experiment pack was modified to establish a neutral tone in order to avoid any bias of the participant's responses. The prevalence of negative indicators in each scenario was also confirmed during the pilot study.

EXPERIMENTAL DESIGN

This research consisted of a randomized counterbalanced experiment as displayed in Figure 2. Each of the 32 participants was randomly assigned to one of the four treatment groups (A, B, C, D). To avoid ordering effects, half the participants had the BSC case first, and half had the QCS case first.

Participants were given a 10 minute briefing on the purpose of the research and instructions in how to complete the scenarios. They were instructed not to share the content or nature of the scenarios with other potential participants until they could be debriefed at the end of the data collection. The first scenario was given to a participant with a half hour allowed for reading, marking a decision, and answering the survey questions. The completed first scenario was then exchanged for the second scenario with the demographic questions included at the end of the second scenario. In order to avoid variance related to group effects or exogenous influences, participants were not allowed to access any resources other than the scenarios during the experiment. The participants were carefully observed through the hour required to complete the two scenarios to preserve the integrity of the classrooms in which they were administered.

The repeated measures, counter-balancing design is shown in Table 2:

Table 2. Randomized Counter-Balanced Experimental Design

	Hospital Scenario First	**Manufacturer Scenario First**
BSC Scenario First	Trt A: 1. BSC scenario (Hospital 2. QCS scenario (Manufacturer)	Trt. B: 1. BSC scenario (Manufacturer) 2. QCS scenario (Hospital)
QCS Scenario First	Trt C: 1. QCS scenario (Hospital) 2. BSC scenario (Manufacturer)	Trt D: 1. QCS scenario (Manufacturer) 2. BSC scenario (Hospital)

MEASURES

Table 3 summarizes the manner in which the research variables were measured in this study. The experiment was designed to capture information sufficiency after each individual scenario and decision. The efficacy of decision making was measured by the ratio of Kill decisions versus Go decisions. Since the case studies were for expert-rated unwarranted projects with a prevalence of negative indicators, the higher the Kill-to-Go ratio, the higher the efficacy of decision making.

Table 3: Sample Measures

Variable	Measure
Perceived Information Sufficiency	Respondent answer to question: "*I had enough information to make an informed decision."* Responses on 5-point Likert scale, from Strongly Agree to Strongly Disagree
Decision Making Efficacy	Percentage of respondents that decided to Kill a given project as described in a scenario

In addition to these quantitative measures, participants were also asked several supplementary open ended questions for additional insights. To paraphrase one of these, "Regarding the go vs. kill decision, briefly explain why you chose your particular course of action." Another such example was, "What information may have helped in making your decision?" These questions were deemed appropriate given the exploratory nature of this research.

RESULTS

After the data was collected, two-sample independent t-tests and difference of proportions z-tests were conducted to determine if there was significant support for the proposed hypotheses.

Hypothesis One posits that the decisions made using the BSC framework will result in higher information sufficiency than those using the QCS framework. This was tested by conducting a two-sample t-test of the mean scores of Perceived Information Sufficiency for the BSC-based scenarios and the QCS-based scenarios, as displayed in Table 4. Hypothesis 1 is supported in this experiment, with a p-value of 0.015.

Table 4. BSC vs. QCS on Information Sufficiency

	Information Sufficiency	
	(Mean Scores*)	Standard Deviation
Balanced Scorecard	2.94	0.80
Quality-Cost-Schedule	3.47	0.98
t-test score	2.37	
Degrees of Freedom	62	
p-value	0.015 (1-tailed)	

*"I had enough information to make an informed decision." (Scale: 1=Strongly Agree to 5=Strongly Disagree)

Hypothesis Two posits that there is a positive relationship between Perceived Information Sufficiency and Decision Making Efficacy. To test this relationship, it was first necessary to define Decision Efficacy for the purposes of this research. A panel of Project Governance experts judged the correct decision in all scenarios to be Kill, therefore decision efficacy can be measured as the percentage of correct (Kill) decisions.

This was tested using a difference of two proportions z-test comparing the Percentage of Kill Decisions relative to the Perceived Information Sufficiency levels. The results of the test indicate significant support for H_2. (Z-test score: 1.822, p = 0.034, one-tailed), as displayed in Table 5.

Table 5. Level of Information Sufficiency vs. Kill-to-Go

		Participant Decision		Total	Percentage Kill Decisions[2]
		Kill	Go		
Participant Perceived Sufficiency of Information	High[3]	14	3	17	0.82
	Low[4]	25	22	47	0.53
TOTAL		39	25	64	

Hypothesis Three posits that there is a direct relationship between the measurement information framework used and Decision Efficacy. Specifically, it is hypothesized that in a project governance context, decisions made using the Balanced Scorecard measurement information framework will result in higher efficacy than those made using the Quality-Cost-Schedule framework.

To test H_3, a difference of two proportions z-test was conducted, comparing the Percentage of Kill Decisions in BSC scenarios to the Percentage of Kill Decisions in QCS scenarios. The overall percentage of Kill decisions for Balanced Scorecard scenarios was 66 percent while for QCS scenarios it was 56 percent. This test did not find significant support for H_3 (Z-test: 0.513, p = 0.30, one-tailed). This finding is shown in Table 6 and explored further in the Discussion section.

Table 6. BSC vs. QCS: Percent Kill Decisions

	Kill	Go	Total	Percentage of "Kill" Decisions
Balanced Scorecard	21	11	32	0.66
Quality-Cost-Schedule	18	14	32	0.56
TOTAL	39	25	64	

DISCUSSION

As a first study of its kind, this research provides direction for further investigations in the area of Measurement Information Frameworks impacts on project portfolio decisions. The results show significant support for H_1 indicating that practitioners should consider the use of the Balanced Scorecard framework as a tool in improving information sufficiency. Additionally, the empirical support for H_2 found in this study indicates that improved information sufficiency is a worthwhile goal in project governance. If information sufficiency can be improved at a reasonable cost, the investment can be recouped in improved project outcomes.

With regard to the lack of support for H_3, a careful examination of the study's results indicated that the decision makers generally have a default selection of "Go" when faced with a Kill/Go project continuation decision. When the decision maker had reached a high state of information sufficiency, they chose to kill the project in significantly higher numbers than when information was not found sufficient. This may account for some of the variance from the expectation that Balanced Scorecard cases would yield higher efficacy of decision making than the Quality-Cost-Schedule "Iron Triangle" approach. There were many examples of a participant choosing Kill in the BSC scenario, reporting a lack of information sufficiency in the QCS scenario and then choosing Go in that scenario. This occurred regardless of the sequence, some having the BSC

[2] "Kill" was judged to be the correct decision by a panel of project management experts.

[3] Number of respondents who answer "Strongly Agree" or "Agree" to the statement: "I had enough information to make an informed decision."

[4] Number of respondents who answer "Strongly Disagree" or "Disagree" to the statement: "I had enough information to make an informed decision."

scenario first and others having the QCS scenario first. The quotes below were from their QCS cases when they had chosen Go on the QCS case and Kill on the BSC case.

> *"No sufficient information to determine, but the long-term may show good results. That's why it needs more time to proceed to collect more data."*
>
> *"I do not see any data about the causes of the issues and I do not see any data to show how much further the schedule may slip."*
>
> *"I don't feel like there is enough info to reverse the original decision."*
>
> *"I want to see more before pulling the plug."*

These results indicated that a deeper examination of the participant data was required. Specifically, there is a need to distinguish the "Go" decisions between "Go – Firm" decisions, indicating that project success is expected and "Go - Wait" decisions indicating that the project had only been given a "stay of execution". It is expected that once the decision maker has reached a higher level of information sufficiency, the projects formerly given a "Go - Wait" decision will then be given either a "Go – Firm" or a "Kill" decision. Further examination of the qualitative data combined with information sufficiency scores revealed the results depicted in Table 7.

Table 7. Measurement Information Framework vs. Firm/Wait

	Go – Firm	Go – Wait
BSC	9	2
QCS	6	8

The qualitative analysis of participant comments in Table 7 suggests that even when making an ineffective decision (in this case, to continue a project with significant negative information) the participants believed the information to be more sufficient when presented in a BSC framework than when presented in a QCS framework. While preliminary, these results indicate that the BSC measurement information framework may be better aligned with a Stage-gate™ governance model than the Iron Triangle framework. The BSC framework yields more decisions that are clear Go or Kill outcomes rather than the Go-Wait outcome that does not align with a Stage-gate™ approach. Further research is needed to explore this finding.

LIMITATIONS

As is the case with any controlled experiment, this study's external validity is limited. Subjects were presented with hypothetical scenarios with which they had no prior experience. They were asked to make a decision without being asked to live with the real-life consequences to the decisions. The two scenarios, while taken from actual organizational decisions, cannot be truly representative of the diverse set of situational and decision contexts faced by governance organizations.

Regarding internal validity, the study could not capture all of the real life dynamics and impacts of information sufficiency on management decision making. Specifically, it is common practice in project portfolio management utilizing Stage-gates™ to have a group, not a single individual, consider each project and render the go or kill decision. Future research will seek to reduce this limitation by asking groups to render the governance decisions.

CONCLUSIONS

This study indicates that use of the Balanced Scorecard framework within IT project governance contributes to decision making efficacy by aiding the decision maker in clearly identifying a project as either worthy of termination or continuation. The positive impact occurs through the moderating impact of improved information sufficiency. Adoption of the BSC framework and other tools that enhance information sufficiency should help IS organizations invest in projects that contribute positively to organizational goals and disinvest in projects that may negatively affect business outcomes. Preliminary results indicate that the BSC framework may have superior alignment with a Stage-gate™ approach to project governance.

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